



jhuang@cs.depaul.edu

Funding for the work discussed in this presentation provided by the National Science Foundation grants # CNS0959924, CCF0810924, CCF 0447594, CCF 0306303, and Siemens Corporate Research, and NASA grant # NNX06AD02G .



Our roots...

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Early work

TEFSE
community

An idea

Towards a
grand
challenge

Beyond the
challenges

TraceLab &
Benchmarks

- Seminal work in the mid 1990s highlighted the traceability problems faced in industrial practice



Beginnings of a community...

Early work

**TEFSE
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TraceLab &
Benchmarks

- George Spanoudakis and Andrea Zisman launched the TEFSE series of workshops to encourage research in this area
- [TEFSE 2009](#), May 18, 2009, Vancouver, British Columbia, Canada
- [TEFSE 2007](#), Also referred to as Grand Challenges of Traceability: GCT , Slade, Kentucky
- [TEFSE 2005](#), November 8, 2005, Long Beach, CA
- [TEFSE 2003](#), October 7, 2003, Montreal, Canada
- [TEFSE 2002](#), September 28th, 2002, Edinburgh, U.K.



A forward looking idea...

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Early work

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TraceLab &
Benchmarks


- Idea: Form a Center of Excellence for Software Traceability (COEST)
- The first CoEST meeting occurred under the St. Louis Arch at ICSE 2005. It was attended by Jonathan Maletic, Guilio Antoniol, Alex Dekhtyar, Jane Cleland-Huang, Jane Hayes, and several students



COEST Organization

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COEST
Center of Excellence for Software Traceability

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Officers

Director:
Jane Huffman Hayes
Associate Professor, University of Kentucky

Vice Director of Europe:
Andrea Zisman
Professor, City University, London

Vice Director of the Americas:
Jane Cleland-Huang
Associate Professor, DePaul University, Chicago

Secretary/Treasurer:
Alexander Egyed
Professor, Johannes Kepler University, Linz, Austria


Body of Knowledge Coordinator:
Alexander Dekhtyar
CalPoly.

Grand Challenges Coordinator:
Olly Gotel
Independent Consultant

Publications Coordinator:
Jonathan Maletic
Professor, Kent State University

Student Coordinator:
Giulio Antoniol
Ecole Polytechnique Montreal, Canada

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NEW BOOK
Software and Systems Traceability

Andrea Zisman
Jane Cleland-Huang
Olly Gotel
Springer Verlag
to be released in **Fall of 2011**

CoEST's vision

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Early work

TEFSE
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An idea

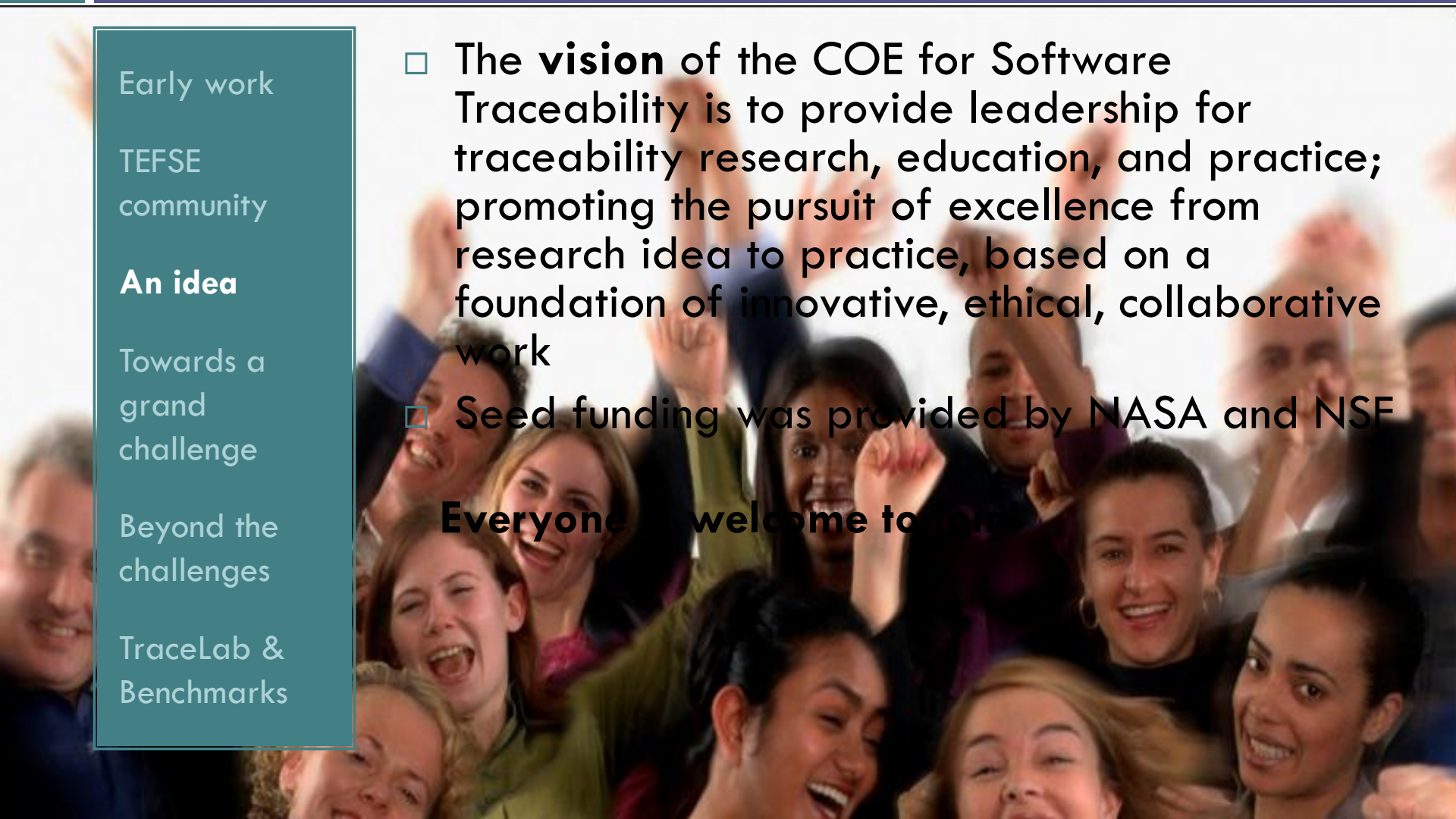
Towards a
grand
challenge

Beyond the
challenges

TraceLab &
Benchmarks

- The **vision** of the COE for Software Traceability is to provide leadership for traceability research, education, and practice; promoting the pursuit of excellence from research idea to practice, based on a foundation of innovative, ethical, collaborative work
- Seed funding was provided by NASA and NSF

Everyone is welcome to join



CoEST's vision will be achieved by:

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challenges

TraceLab &
Benchmarks

- Identifying the **grand challenges** of traceability
- Fostering international research **collaborations**
- Developing a repository of **benchmarks** for traceability research
- Delivering **tutorials** in the areas of requirements engineering and traceability
- Constructing a **Body of Knowledge** for traceability
- Cultivating **partnerships** with industry and academia
- Providing the **infrastructure** needed to support the above

Lessons from a wise cat

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In *Alice in Wonderland*, Alice encounters the Cheshire Cat and asks for directions

The cat responds that it depends upon where she wishes to go

Alice says she doesn't know, whereupon the cat tells her that it doesn't matter which way she walks



Towards the Grand Challenges...

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**Towards a
grand
challenge**

Beyond the
challenges

TraceLab &
Benchmarks

- A group of CoEST members met at NASA's IV&V facility in Fairmont, WV, to flesh out the grand challenges of traceability
- We produced GCT 1.0
- Over the past 2-3 years, a smaller group of people have been working to transform GCT 1.0 into a more cohesive research roadmap

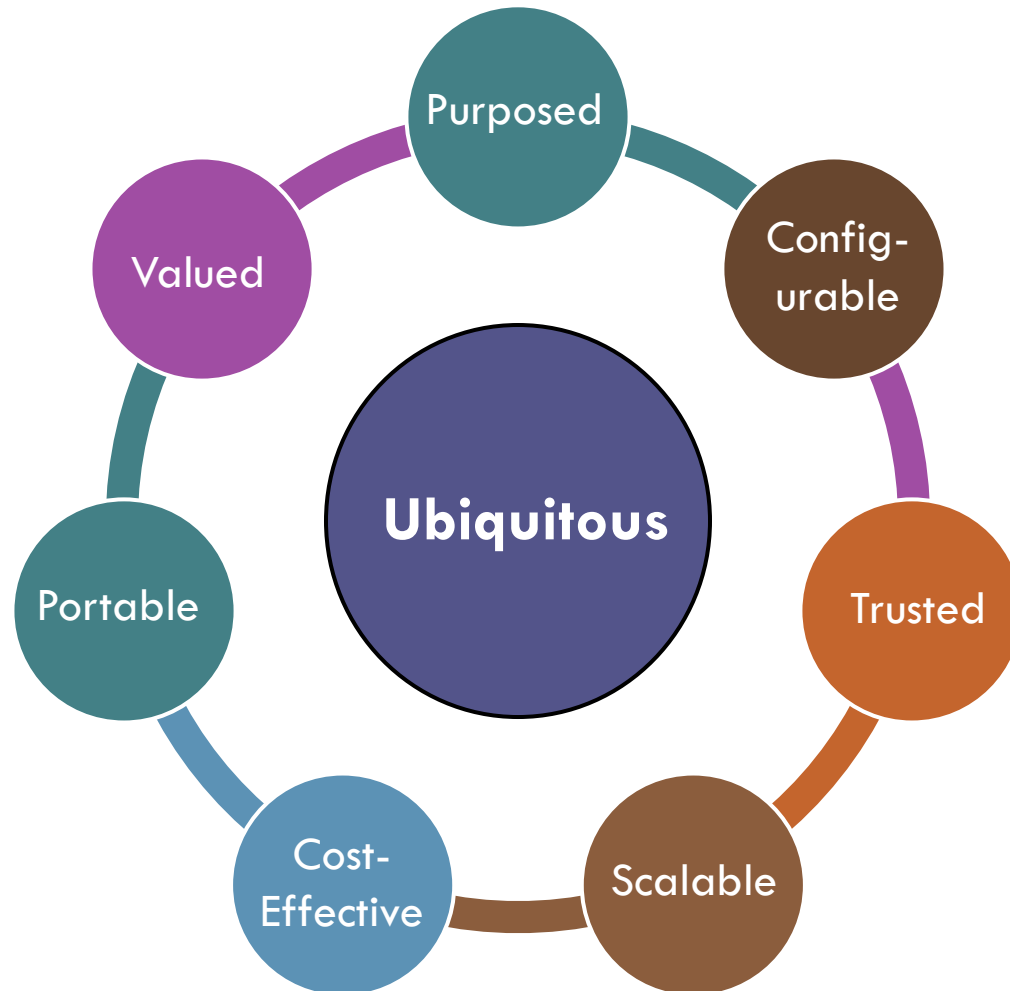
The Traceability Grand Challenge

- Traceability is always there, without having to think about getting it there. Traceability is neither consciously established nor sought; it is built-in and effortless. It has effectively ‘disappeared without a trace’
- Is our challenge **feasible**? Do practitioners agree that it is the **right** challenge?

The Goals of Traceability

Olly Gotel, Jane Cleland-Huang, Alex Dekhtyar, , Jane Huffman Hayes, Andrea Zisman, Alex Egyed, Guilio Antoniol, Jonathan Maletic, Stephanie Ferguson, Ken McGill, Tim Menzies, Marcus Fisher, Lisa Montgomery, Brian Berenbach, Paul Gruenbacher, & numerous PhD students....

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For each Challenge

- Definition
- Description of desired outcome
- Problem addressed
- High level goals (3-4)
- Impact of challenge area on trace strategy, use, creation and maintenance
- Research Projects (1-2)
- Sub Research Projects (7-10)
- Industry Practice objectives (3-5)

GCT Summary

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Challenges
have been
defined

Early version
of the
challenges
have gone
live

- Each of the 8 challenge areas have been fully mapped to goals, research projects, and industrial adoption strategies
- Grand Challenges 2.0 are launched at <http://www.CoEST.org>
- Grand Challenges will serve as a **roadmap for guiding traceability research and advancing the state of practice**

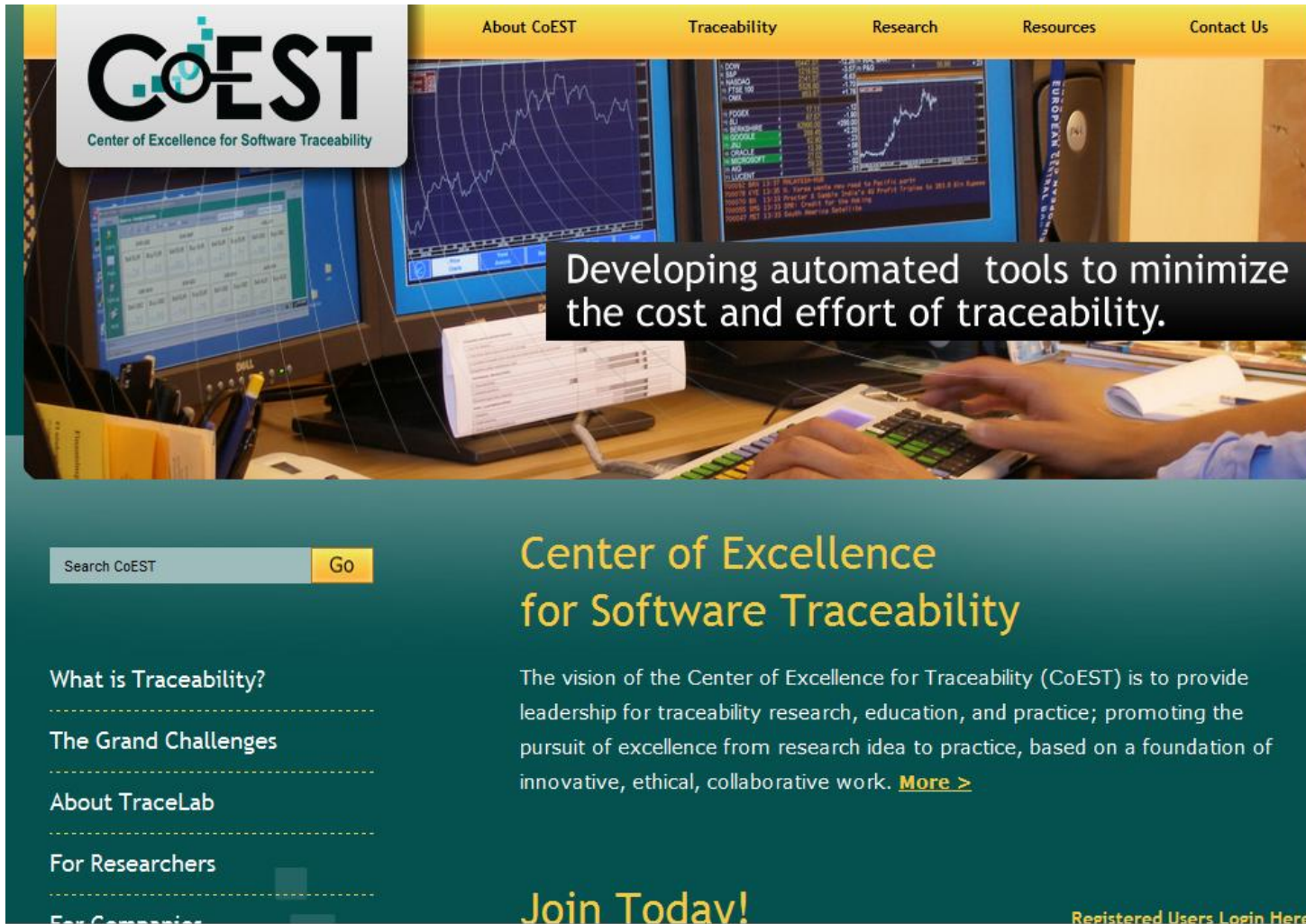
Ubiquitous Traceability

- **Major Research Project:** RP1.1 Provide automation such that traceability is encompassed within broader software and systems engineering processes, and is integral to all tool support
- **Supporting Research Projects:** RP1.2 Embed traceability into all the software and systems engineering techniques and methods that it facilitates, and transfer this into industrial tool support
- RP1.3 Total automation of trace creation and trace maintenance, with quality and performance levels superior to manual efforts

Tracking our progress...

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CoEST
Center of Excellence for Software Traceability

About CoEST Traceability Research Resources Contact Us

Developing automated tools to minimize the cost and effort of traceability.

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Center of Excellence for Software Traceability

The vision of the Center of Excellence for Traceability (CoEST) is to provide leadership for traceability research, education, and practice; promoting the pursuit of excellence from research idea to practice, based on a foundation of innovative, ethical, collaborative work. [More >](#)

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Research Projects

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UPCOMING EVENT


Workshop on
**Traceability in Emerging
Forms of Software
Engineering (TEFSE)**

Monday, May 23rd

held in conjunction with
**the International Conference
on Software Engineering (ICSE)**
Waikiki, Hawaii

NEW BOOK

**Software and Systems
Traceability**



Andrea Zisman
Jane Cleland-Huang

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You are here : [Home](#) > [Research](#) > [Research Challenges](#) > Traceability Automation and Integration

Project 1: Traceability Automation and Integration

Providing automation such that traceability is encompassed within broader software and systems engineering processes, and is integral to all tool support.

Supporting Research Projects

Research Project 1.2

Embed traceability into all the software and systems engineering techniques and methods that it facilitates, and transfer this into industrial tool support.

Importance ●●●●● Difficulty ●●●●● Progress ●●●●● [Comments](#) [Rating](#)

Research Project 1.3

Total automation of trace creation and trace maintenance, with quality and performance levels superior to manual efforts.

Importance ●●●●● Difficulty ●●●●● Progress ●●●●● [Comments](#) [Rating](#)

Research Project 1.4

Investigate novel ways to define the traceability strategy, such as in an executable way so that the traceability solution simply follows from the specification of need, as per model-driven or formal development.

Importance ●●●●● Difficulty ●●●●● Progress ●●●●● [Comments](#) [Rating](#)

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How do we get there?

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Early work

TEFSE
community

An idea

Towards a
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**Beyond the
challenges**

MRI funding

- So now we know where we want to go, but how do we actually get there?
- TEFSE (ongoing)
- CoEST
 - ▣ Grand Challenges
 - ▣ Benchmarking
 - ▣ TraceLab
 - ▣ Education and outreach

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MRI funding

-

Benchmarks

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**TraceLab &
Benchmarks**

- A benchmark is a point of reference by which something can be measured
 - ▣ A program that is specially designed to provide measurements for a particular operating system or application
 - ▣ A set of performance criteria which a product is expected to meet
 - ▣ A set of conditions against which a product or system is measured

Benchmarks

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challenges

**TraceLab &
Benchmarks**

- **Define a task**
 - ▣ Retrieve/Generate traces from high level to low level requirements
- **Provide datasets**
 - ▣ CM1, HIPAA to World Vista, IBS
- **Agree on a core set of metrics**
 - ▣ Recall, Precision, Lag, Average Precision (??)
- **Capture/Report benchmarked results**

What about Qualitative Studies?

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Early work

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challenges

**TraceLab &
Benchmarks**

- Several identified challenges are more qualitative in nature
- How do we comparatively evaluate processes and methods which don't lend themselves to quantitative metrics?

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TraceLab & Benchmarks

- [illegible]

A framework enables us to collect metadata on each project, and then as a community move towards answering higher-level questions such as “under what conditions does technique X work most effectively?”

TraceLab- The Vision

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Early work

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**TraceLab &
Benchmarks**

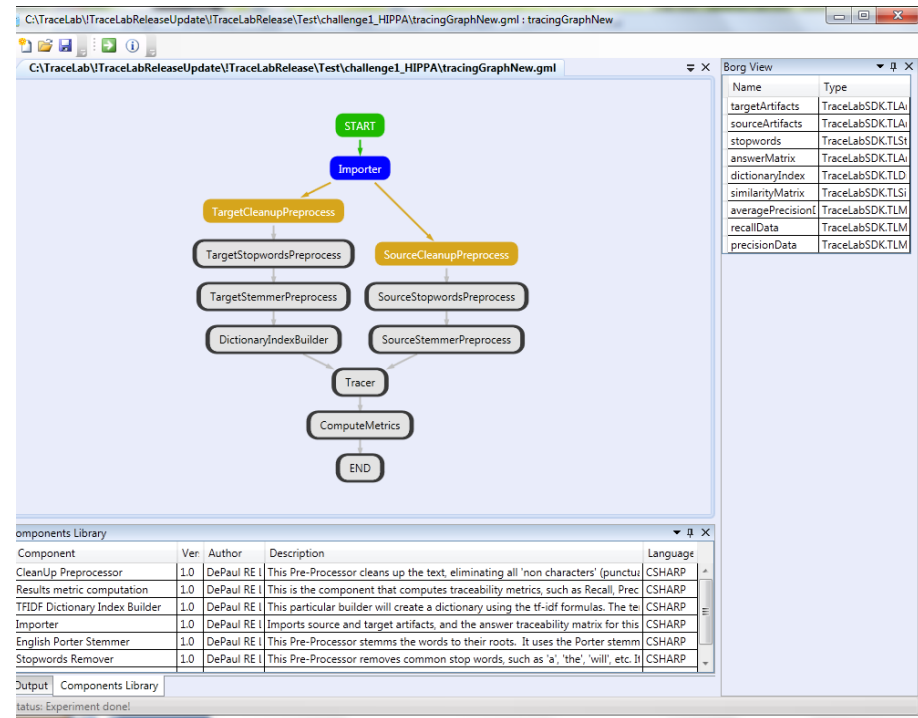
- Build a tool, similar to MatLab, but designed specifically for the traceability community
- Equip new researchers with basic algorithms and components
- Make it easier to perform rigorous comparative evaluations
 - ▣ Datasets
 - ▣ Benchmarks
 - ▣ Repeatable experiments
- Permit practitioners to use “best” algorithms for specific benchmark

Major Research Instrumentation

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- Currently has capabilities to design and run experiments
- Next features will integrate with benchmarking



TraceLab Version 0.1

TraceLab developers: Ed Keenan,
Adam Czauderna, and Greg Leach

Traceability Research Timeline

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1995 &
earlier
Seminal
work in
trace-
ability

Rudimentary
tools

2nd Generation of
Trace features in RM
tools

Technology
transfer
pilots

What next?

The Grand
Challenges
provide a
roadmap for
future
research
efforts and
the
mechanism
for tracking
progress
towards our
goals

1995-2010

Numerous researchers work on various traceability
topics receiving funding from NASA, NSF, & Industry



funded
by NASA
& NSF
2006/7

Grand
Challenge
Workshops
held,
GCT 1.0
released

2010: MRI
funded by
NSF for \$2M

GCT 2.0
released,
Jan. 2011



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Backup

What is a grand challenge?

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What
makes this
a good
Grand
Challenge?

Is “Traceability” a grand challenge?

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- Is traceability **important**? Why?
- Is traceability **difficult** to achieve?
- Do we have a **clear vision** of where we want to go?

Benchmarks

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search ID: dcr0734

"I MUST SAY, SIMMS, WHEN YOU'RE HOT YOU'RE HOT BUT WHEN YOU'RE NOT YOU'RE NOT!"

Recall vs. Precision

problem – small changes in thresholds can have inordinate impact upon recall vs. precision – creating zigzag graphs. For benchmarking metrics, how do we overcome this?

Benchmarks

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"I TRIPLED MY SALARY
TO GIVE YOU ALL A GOOD BENCHMARK!"

**High water
marks—**

Will high
benchmarks
thwart
innovation?

Is this a good or
bad thing?

Benchmarks

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"WHOSE IDEA WAS IT TO USE ENRON AS A BENCHMARK?"

search ID: dr00745

Trust –

What kinds of checks and balances do we need to put into the process to make sure that benchmarks are fair?

How do we make comparisons anyway?

Benchmark issues

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Early work

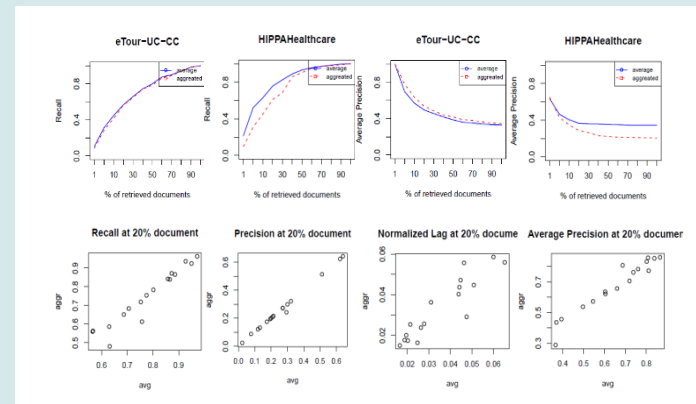
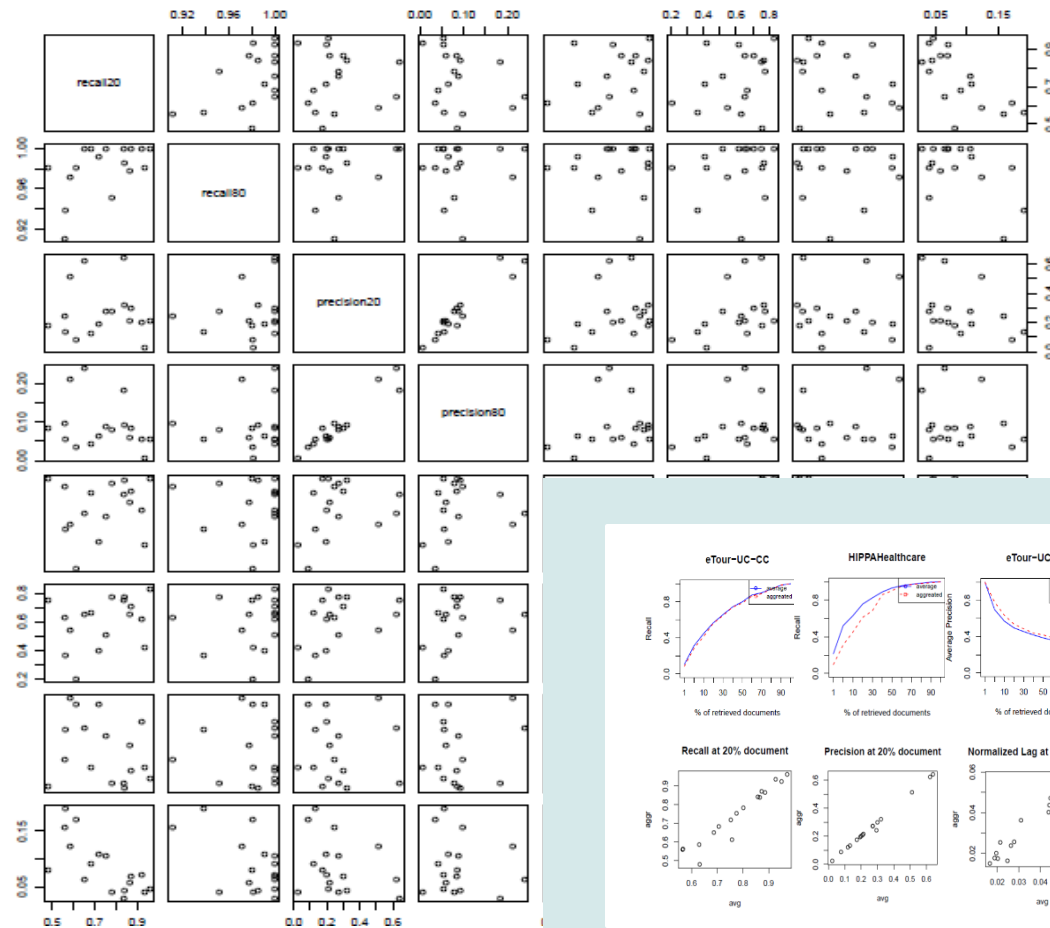
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**TraceLab &
Benchmarks**



Yonghee's work

Benchmark insights

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Early work

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Beyond the
challenges

**TraceLab &
Benchmarks**

- What is the purpose of benchmarking our community?
 - ▣ What do we hope to accomplish from benchmarking?
- What are the major pitfalls of benchmarking in the traceability community?
 - ▣ How can we avoid them?